

**INFRASTRUCTURE AND TRADE PREFERENCES FOR THE LIVESTOCK SECTOR:  
EMPIRICAL EVIDENCE FROM THE BEEF INDUSTRY IN AFRICA**

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Abstract

Trade preferences are expected to facilitate global market integration and offer the potential for rapid economic growth and poverty reduction for developing countries. A remaining concern is that those preferences do not always guarantee sustainable external competitiveness to beneficiary countries and may risk discouraging their efforts to improve underlying productivity. This paper examines the EU beef import market where several African countries have been granted considerable preferential treatment. The estimation results suggest that profitability improvement achieved by countries under the Cotonou protocol compares unfavorably with the returns to non-beneficiary countries in recent years. Rather, it is shown that public infrastructure, such as paved roads, has an important role to play in lowering production costs and thus increasing external competitiveness and market shares.

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## I. INTRODUCTION

In many of the poorest countries, livestock farming is one of the important industries to develop for not only economic growth but also poverty reduction and environmental protection. The livestock industry contributes about 1.2 percent of the global GDP—as much as 5 percent for some countries—and is growing by about 2.5 percent per annum. Low-income and lower-middle income countries are relatively heavily dependent on the livestock industry (Table 1).<sup>1</sup> About one billion people in rural areas are still dependent on livestock for their livelihood in developing countries; 75 percent of the world’s poor live in rural areas (OECD, 2006).<sup>2</sup> Given the rapidly increased demand for livestock products led by vigorous growth and urbanization, a key challenge is how to ensure efficient production in the livestock sector. It is still unclear whether it could be achieved by establishing institutions, such as agricultural credit and trade agreements, or providing physical infrastructure, such as slaughterhouses and transport infrastructure (e.g., roads and ports).

Table 1. Contribution of Livestock Production to GDP, 2001

|                        | Production<br>(Billions of U.S. dollars) | Share of GDP<br>(Percent) |
|------------------------|--|---------------------------|
| World                  | 380.1                                    | 1.2                       |
| High income            | 160.6                                    | 0.6                       |
| Upper middle income    | 44.7                                     | 1.9                       |
| Lower middle income    | 147.9                                    | 4.9                       |
| Low income             | 26.9                                     | 3.1                       |
| Memorandum item:       |  |                           |
| Agriculture production | 1,138.7                                  | 3.6                       |

Source: Author’s estimation based on *FAOSTAT* and *World Development Indicators*.

Using trade data from the European Union (EU), this paper aims at examining the effects of international trade preferences and public infrastructure on productivity changes in livestock production. A fundamental question is this: Infrastructure is intuitively essential for reducing

<sup>1</sup> National accounts data on the gross production value of livestock products may not be published in most developing countries. These figures in Table 1 are estimated from livestock—i.e., beef and veal, buffalo meat, mutton and lamb, pig, chicken, duck, goose, turkey, and goat meat—production data from *FAOSTAT* and the regional average export prices of individual items, which are calculated under the law of one price in internal and external markets. In the case of Botswana, which is one of the upper-middle income countries in Africa, its national accounts data indicate that the livestock share of GDP was about 2 percent in 2002/03.

<sup>2</sup> In 2006, OECD POVNET has published a policy guidance note, “Promoting Pro-Poor Growth: Agriculture.”

production and export costs, but does it really matter to revive the livestock sector? On the other hand, industrial countries have been using preferential trade arrangements to assist developing countries in evolving the agriculture sector, in which the majority of rural people make their living. Is it really an effective way? The experiences of some African countries benefiting from preferential access to the European beef and veal market can provide several pieces of evidence to answer these questions.

The current paper applies a three-stage least squares (3SLS) technique to estimate the demand and supply functions of beef and veal in the EU import market. The estimated price cost margins indicate that preferential trade arrangements may be necessary but not sufficient to improve the profitability of beef business in Africa. Another important finding from the estimated supply equations is that infrastructure, particularly quality roads and electricity, is an important contributor to productivity growth. If trade preferences defuse international competitive pressure without encouraging efforts toward efficient production, they might have an adverse effect on beneficiary countries over the long term.

Infrastructure is generally indispensable to economic development (e.g., Easterly and Levine, 1997; Canning, 1998; Fay and Yepes, 2003; Esfahani and Ramírez, 2003; Estache, 2006). Most recently, Calderón and Servén (2004), using a generalized method of moments (GMM) technique, show that growth is positively affected by the stocks of infrastructure, especially telecommunications network.

There is no reason why the only livestock industry would be an exception to this, though it may be arguable how to define livestock-specific infrastructure given available data. Rural infrastructure usually includes irrigation, electricity and marketing infrastructure, such as telecommunications and transport infrastructure.<sup>3</sup> Government spending on rural infrastructure is important for poverty reduction and agricultural productivity gains (Fan *et al.*, 2002, 2004).

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<sup>3</sup> Pinstруп-Andersen and Shimokawa (2006) also provide a good summary of rural infrastructure and agricultural development.

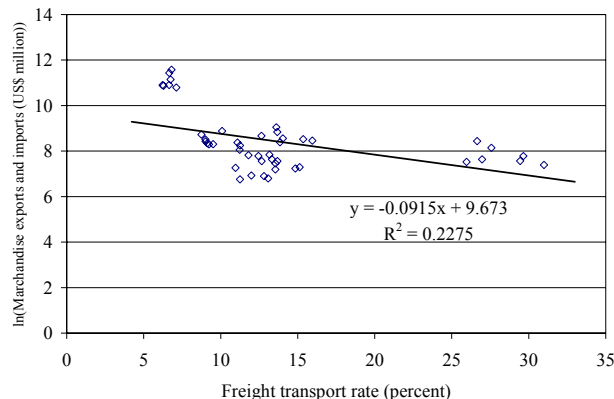
In the African context, poor road and logistics conditions are a common bottleneck to increase intra-regional trade (Buys *et al.*, 2006, Broadman, 2007).<sup>4</sup> In addition, inadequate market information flows and high illiteracy among market operators are hampering livestock trade integration (Williams *et al.*, 2006). Table 2 summarizes the key results related to a trade-infrastructure linkage in these recent studies.<sup>56</sup>

Table 2. Recent Selected Studies on Infrastructure and Trade in Africa

| Source                        | Methodology                           | Area   | Industry | Main result relevant to infrastructure and trade 1/   |
|-------------------------------|---------------------------------------|--|----------|---|
| Buys <i>et al.</i> (2006)     | Gravity model                         | Sub-Saharan Africa   | All      | The elasticity of bilateral trade with respect to the paved road share is estimated at 1.52.  |
| Williams <i>et al.</i> (2006) | Marketing cost analysis               | West Africa  | Cattle   | The share of transportation and handling costs in final market prices is about 0.01, meaning that a transport cost saving could lower the market prices and improve competitiveness slightly. |
| Broadman (2007)               | Comparison of freight transport rates | Ethiopia, Ghana, Kenya, Malawi, South Africa, Tanzania, Uganda, and selected Asian countries | All      | The elasticity of total trade with respect to freight costs is estimated at 1.26.   |

1/ Author's estimation based on the original studies.

Figure 1. Trade Value and Freight Transport Rate in Selected African Countries



Source: Author's recalculation from IMF *Balance of Payment Statistics*.

<sup>4</sup> It is indicated that despite geographical proximity, freight costs from South Africa to Angola are as expensive as those from China to Angola.

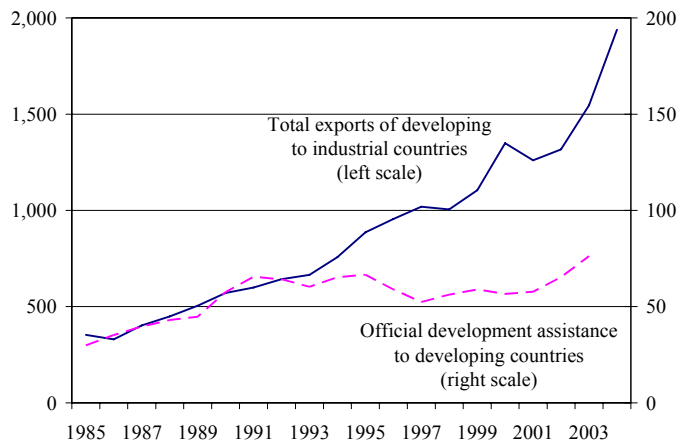
<sup>5</sup> In Buys *et al.* (2006), the road quality is measured by the weighted average of the share of paved roads, per capita GDP and governance.

<sup>6</sup> The Broadman's result is recalculated from a simple regression of the sum of merchandise exports and imports on the freight transport rate for the same sample countries. Data are extended to 2005, and the year-country observations are pooled in the regression. The coefficient is estimated at -0.091 with its standard error of 0.025 (Figure 1).

From the institutional side, increasing attention has been paid to the notion that trade integration into global markets offers the potential for rapid agricultural growth and poverty reduction (IMF and World Bank, 2002). Various trade preferences have been granted to developing countries, despite the lack of theory linking trade preferences to productivity improvement. An implicit expectation shared by the international donor community is that beneficiary countries could improve their efficiency and competitiveness during the preference period. But, trade preferences alone may not warrant beneficiaries' sustainable growth.

The potential benefits of the preferential access to industrial economies would be sizable, if such preferences are well designed. It could stimulate exportation and domestic employment and encourage economic diversification. The benefits may have outweighed official development assistance (ODA) particularly in recent years. While the imports of industrial economies from developing countries have doubled over the last decade, the total amount of ODA has increased more modestly (Figure 2).<sup>7</sup>

Figure 2. Official Development Assistance and Exports to Developed Countries, 1985–2004  
(In billions of U.S. dollars)



Sources: *World Development Indicators*; IMF *Direction of Trade*.

Nonetheless, it cannot be overemphasized that proliferation of trade preferences poses risks that developing countries might continue to be passively involved into the world trade system.

This concern became real to many developing countries when the Multi-Fiber Agreement (MFA) expired in January 2005 (Nordås, 2004; USITC, 2004; Alexandraki and Lankes, 2004; IMF, 2005).<sup>8</sup> The elimination of trade preferences is particularly critical for the African, Caribbean and Pacific (ACP) countries that are exporting agricultural commodities given duty-free access to the U.S. and EU markets. Notably, the current Cotonou Agreement will expire in 2008 and be replaced with new trade schemes compatible with the World Trade Organization (WTO) rule.

To assess the trade preference impact on exports, there are at least four approaches, as summarized in Table 3. The first is the pricing-to-market technique (e.g., Dornbusch, 1987; Feenstra, *et al.*, 1996). The advantage, which is exploited by the current paper, is that it allows us to investigate into underlying productivity changes without observing the country-specific micro cost information. Only aggregate data are needed (e.g., Nevo, 2001).<sup>9</sup> Based on the estimated consumer demand, this paper will calculate the price-cost margins (PMCs) of beef production and trade. Reed and Saghaian (2004), using the similar approach, estimate the price elasticity of beef demand in the Japanese import market at 3 to 10 in absolute terms.

The second approach uses a gravity type of model to test whether a particular preferential scheme increases trade volumes between the countries involved (e.g., Nilsson, 2002; Manchin, 2004). Nilsson (2002) shows that the effects of the Lomé Conventions are greater than those of the generalized system of preferences (GSP).<sup>10</sup> However, its latent weakness is

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<sup>7</sup> Although this argument is very static and *does* ignore the multiplier effects, the potential impacts of trade preferences are undoubted.

<sup>8</sup> Alexandraki and Lankes (2004) point out that a fifth of the middle-income countries direct more than 75 percent of their exports to the Quad (Canada, the EU, Japan and the United States) under highly benevolent schemes, and that the high dependence on the Quad markets is interpreted as their potential vulnerabilities to preference erosion caused by trade liberalization.

<sup>9</sup> The dependency on aggregate data has shortcoming as well. For instance, this approach cannot address possible regional heterogeneity within a country. In some countries one area is exporting beef and another is importing. However, such a situation cannot be taken into account in this study.

<sup>10</sup> This may be contradictory to the widespread perception that one of the reasons for the phasing out of the Lomé Conventions was the inability of the trade arrangements under Lomé to benefit most ACPs (McDonald, 2002; Rocha, 2003). However, Nilsson's estimates show that the GSP scheme increases exports to the EU market by 34 to 59 percent, while the incremental effects of the Lomé Conventions range from 45 to 69 percent.

that there is no theoretical foundation behind the model, even though well fitted to actual trade data (Deardorff, 1984).<sup>11</sup>

The third calculates the preference margin to make a comparative analysis of the export revenues of beneficiary countries with an estimate of the revenues that might have been earned without the preferential scheme (e.g., Alexandraki and Lankes, 2004).<sup>12</sup> The approach is easy to apply, but it is in danger of overestimating the preferential effect because the competitive international market prices is the lowest possible and may not be achievable, particularly to developing countries, due to incomplete information and lack of channels.<sup>13</sup>

Finally, the fourth approach to assess the impact of trade preferences—in particular preferences being eroded—on exports is based on a computational general equilibrium (CGE) model, such as the Global Trade Analysis Project (GTAP) model (e.g., Nordås, 2004; Mlachila and Yang, 2004).<sup>1415</sup> As well known, however, this approach is vulnerable to the “black-box” criticism; the confidence in CGE is invisible and remains open to argument.

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<sup>11</sup> From the more general perspective, a gravity regression tends to show that the bilateral GSP extended from the North to developing countries have a stronger positive effect on trade than a multilateral trade agreement (Rose, 2002). This does not mean that all multilateral trade institutions are ineffective. More precisely, Rose’s evidence indicates that countries belonging to the GATT/WTO do not have significantly different trade patterns than non-member countries. Paiva (2005) finds that some regional free trade agreements (FTA) are also effective in enhancing trade between the partners involved.

<sup>12</sup> Alexandraki and Lankes (2004), focusing on banana and sugar preferences, estimate the average preference margin for 76 middle-income countries at about 5 percent. The countries eligible for the bananas protocol include Belize, Côte d’Ivoire, Dominica, Dominican Republic, St. Lucia, St. Vincent and the Grenadines, and Suriname. On the other hand, the major beneficiaries from the sugar protocol are Mauritius, Fiji, Guyana, and Barbados.

<sup>13</sup> Subject to this risk, the following section *will* calculate the preference margins for major beef and veal exporters.

<sup>14</sup> Nordås (2004) shows that China and India will come to dominate world trade in textiles and clothing, and that other countries will severely suffer from preferences erosion. For Sub-Saharan Africa, the U.S. preferences under the African Growth and Opportunity Act (AGOA) are considered insufficient for African countries to maintain the market shares on U.S. apparel imports (USITC, 2004).

<sup>15</sup> Mlachila and Yang (2004) find that the phase out of textiles and clothing quotas would substantially reduce the Bangladeshi textile and garment exports, threatening the country’s balance of payments and employment. It is attributed to the fact that the country has neglected improving its fundamental competitiveness in the textile industry for years.

Table 3. Recent Selected Studies on Trade Preferences

| Source                        | Methodology                   | Area                    | Industry                    | Major dependent variable         | Trade preferences        | Estimation result         |
|-------------------------------|-------------------------------|-------------------------|-----------------------------|----------------------------------|--------------------------|---------------------------|
| Reed and Saghaian (2004)      | Demand elasticity estimation  | Japan                   | Beef                        | Import prices                    | n.a.                     | 3~10 1/                   |
| Nilsson (2002)                | Gravity model                 | ACP                     | All                         | Imports by each European country | Lome Conventions and GSP | E.g., 0.55 for Belgium 1/ |
| Manchin (2004)                | Gravity model                 | Middle-income ACP       | All                         | Preference utilization rate      | Cotonou Agreement        | 0.2 1/                    |
| Alexandraki and Lankes (2004) | Preference margin calculation | Middle-income countries | Banana, sugar, and textiles | Preference margin                | Cotonou Agreement        | 4.9% 2/                   |
| McDonald (2002)               | Input output table            | Botswana                | Beef                        | GDP                              | Cotonou Agreement        | -0.5% 3/                  |
| Nordås (2004)                 | CGE                           | All                     | Textiles and clothing       | Exports of textiles and clothing | MFA expiration           | E.g., +34% for China 4/   |
| Mlachila and Yang (2004)      | CGE                           | Bangladesh              | Textiles and clothing       | Domestic production              | MFA expiration           | -17% 5/                   |

1/ Implied elasticities.

2/ Average total preference margin.

3/ Percentage point changes in GDP before and after the Cotonou protocol elimination.

4/ Percentage point changes in U.S. clothing import market share before and after MFA elimination.

5/ Percentage point changes in domestic clothing production before and after MFA elimination.

There is no formal theory to support trade preference programs for facilitating global trade integration; but the Mill-Bastable test, which is commonly accepted in the infant industry argument, may provide a certain guideline to justify protection (e.g., Corden, 1997). It requires the presence of dynamic external learning effects, temporariness of protection, and the positive cumulative net benefits of protection (Melitz, 2005). Thus, the validity of trade preferences must depend on the nature of the target industry, i.e., the extent to which positive externalities, such as learning-by-doing, exist in production.

The following sections of this paper are organized as follows. Section II describes an overview of the cattle industry and the EU preferences on beef and veal. Section III develops an empirical model for estimating the supply and demand functions for imported beef. Section IV discusses data and several econometric issues. Section V presents the basic estimation results, and Section VI calculates the PCMs of beef production and quantifies the potential impacts of infrastructure development to draw some policy implications in this industry.

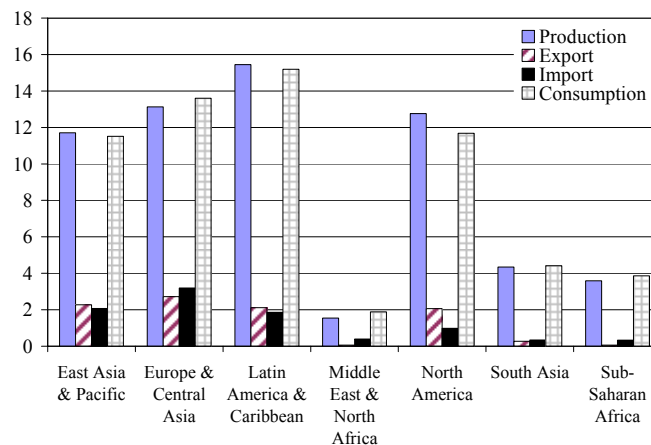


## II. BEEF INDUSTRY AND TRADE PREFERENCES

### *Overview of beef production and trade in the world*

Bovine meat production amounted to 62 million tons a year over the world, of which about 25 percent was consumed in Latin America and Caribbean (Figure 3). Europe and Central Asia consumed about 20 percent of the world production. Sub-Saharan Africa consumed 4 million tons and produced 3.8 million tons of beef and veal. While the volume of beef imported by European and East Asian countries is sizable, Africa's involvement in the international trade appears very limited in this area. Sub-Saharan Africa contributes to only less than 1 percent of total beef exports in the world.

Figure 3. Beef Production, Exports, Imports and Consumption by Region, 2004  
(In millions of tons)



Source: FAOSTAT.

### *Lomé Conventions and Cotonou Agreement*

The commodity protocols of the Cotonou Agreement provide selected ACP countries with considerable trade preferences in the EU import market. The historical economic and trade relationship between the EU and the ACP countries has been governed by four Lomé Conventions (1975–2000) and the following Cotonou Agreement signed in January 2000. The scope of these agreements covered nonreciprocal trade preferences with environmental and human rights issues incorporated. The basic principle was that ACP countries had duty- and quota-free access to export their industrial and agricultural products to the EU market, except for sugar, bananas, rum and beef ruled under the special protocols. These protocols

aimed at maintaining the market shares of countries whose potential for diversifying exports is deemed very limited. On the other hand, many non-ACP developing countries were covered by the GSP scheme, which imposed additional restrictions on textiles and apparel, as well as steel and coal products.<sup>16</sup>

One of the reasons for renegotiating the Lomé Convention was the alleged inability of the Lomé trade preferences to increase access of less developed ACP countries to the EU market, due to the lack of institutional and human capacity (Nilsson, 2002; McDonald, 2002). Consequently, the Cotonou Agreement following the renegotiation stipulates the broad development objective as an important element, accompanied with two complementary goals: poverty reduction and stability in the region (Rocha, 2003).<sup>17</sup>

The Cotonou Agreement is not a comprehensive agreement but a commitment to conclude a more general economic partnership agreement (EPA) between the two regions by 2008. New arrangements are under negotiation and will be based on the current GSP arrangements in conformity with WTO rules.

For the BLNS countries (Botswana, Lesotho, Namibia and Swaziland) joining the Southern Africa Custom Union (SACU), agricultural preferences under the Cotonou protocols are most likely to be eliminated by the introduction of new arrangements. This is because one of the SACU members, South Africa, has already concluded a free trade agreement (FTA) with the EU, which will force the BLNS to be engaged in a reciprocal trade agreement with the EU under the similar framework. If the BLNS cannot agree on an EPA, Botswana, Namibia and Swaziland would revert to the GSP status. However, this would require strict border

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<sup>16</sup> The GSP scheme was introduced by UNCTAD in 1968, and under the scheme industrial countries could provide nonreciprocal and autonomous trade preferences with low tariffs to all developing countries. The general arrangements cover about 7,000 products, of which 3,000 are classified as non-sensitive products. Of particular note, for the ACP countries both the GSP and the Cotonou Agreement are available, but the utilization of the GSP preferences by the ACP members is very limited (Manchin, 2004).

<sup>17</sup> Article XXXIV (1) of the Cotonou Agreement.

controls in the SACU region and undermine the existing benefits from the free trade within the region (Rocha, 2003).<sup>18</sup>

### ***The beef and veal protocol***

The level of a preferential quota granted to each country is determined by the relative importance of the cattle industry for each economy (Figure 4). The Cotonou beef protocol grants Botswana the largest preferences among the ACP countries, because the country's industrial structure has very concentrated on diamond production and livestock remains a socially and economically important sector for the economy.<sup>19</sup> It is allowed to export a maximum of 18,916 tons per year of beef and veal to the EU market under the condition that customs duties are reduced by 92 percent up to the quota. This is practically interpreted as a quota- and duty-free access for Botswana. Under the preferences, Botswana has exported on average 7,200 tons per annum of chilled meats of bovine animals to European countries, of which about 70 percent has been exported to the U.K.; 15 percent to Germany; 10 percent to Greece; and 5 percent to France. The average number of slaughtered cattle is around 130,000 to 160,000 head per year.

Following Botswana, Namibia is given a preferential quota of 13,000 tons; Zimbabwe, 9,100 tons; Madagascar, 7,579 tons; Swaziland, 3,363 tons; and Kenya, 142 tons. Namibia markets 2.5 million head of cattle about 300,000 head or 80,000 tons of beef a year. The livestock sector is one of the traditional industries for the country, accounting for over one-half of agricultural output. 70 percent of populations are still dependent on agriculture in Namibia. Zimbabwe is the eleventh largest cattle holder in Africa, producing about 100,000 tons of beef and veal. Madagascar is the seventh largest beef producer, supplying 150,000 tons of

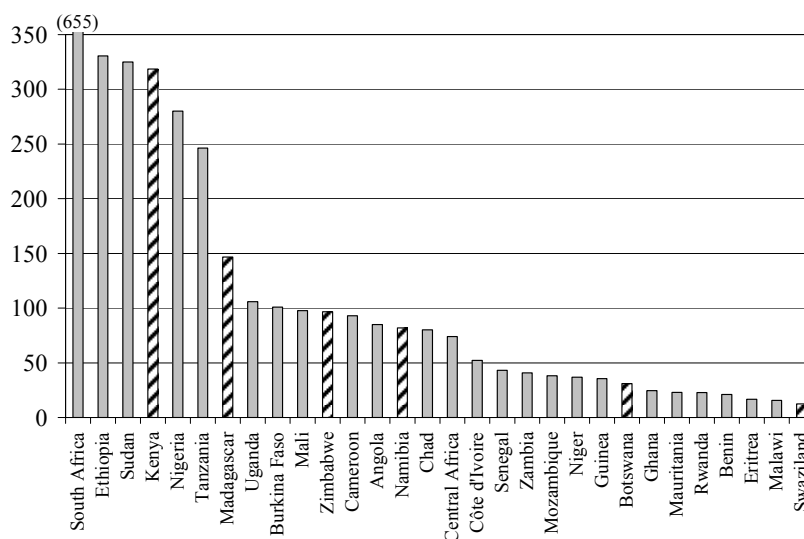
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<sup>18</sup> The same difficulty would occur, even if the BLNS choose to pursue a broader EPA with the EU as members of the South African Development Community (SADC), which aims at concluding a regional FTA by 2008. It remains uncertain that the SADC would form a custom union in the foreseeable future. However, as long as South Africa is included as a member, other SADC countries would be faced with a conflict between the intra- and inter-regional trade agreements.

<sup>19</sup> Beef is the third largest export earner, following diamonds and other minerals, and the livestock sector produces about 2 percent of GDP. In addition, beef processing contributes to about 10 percent of manufacturing gross value added, which amounts to 5 percent of GDP. Throughout the colonial period and since independence, the cattle industry has been the center of agriculture because of the country's erratic rainfall and little arable land (Remsay et al., 1996).

beef every year. Swaziland produces 44,000 head or 12,000 tons of beef. In these countries, the cattle industry is not only the center of the rural economy but also an important export earner. Kenya is one of the largest beef producers in Africa. The livestock sector contributes to about 1 percent of GDP, despite the large number of processed cattle averaging over 2 million head or 320,000 tons per annum.

Figure 4. Beef Production in Africa, 2004  
(In thousand tons)



Source: FAOSTAT.

In terms of exports to the EU market, following Botswana, all beneficiaries from the beef protocol but Kenya, have exported the majority of African beef and products to the European market. Exports from other Sub-Saharan African countries remain very limited.<sup>20</sup> Beef export prices differ significantly across countries, possibly due to horizontal differentiation and different food safety standards. While the average export price is 2.1 euro per kilogram for Botswana, some other exporters have much higher or lower prices ranging from 0.5 to 4.7 euro per kilogram.<sup>21</sup>

<sup>20</sup> Provided that the current preferences were removed, large cattle producers in the region, such as Ethiopia, Kenya and Sudan, would have a good potential for exporting beef to the EU even without the preferences. There are several countries that have significantly increased beef production in recent years, such as Angola, Cameroon and Chad. They may also foster the cattle industry as a strategic export sector.

<sup>21</sup> This implies that beef and veal are somewhat product-differentiated. A certain degree of product differentiation is methodologically important to construct our empirical model. See Section III.

Table 4. Beef Exports from Africa to EU Market, 1990–2004

|                  | Annual export volume<br>(In tons) | Average price<br>(In euro per kg) |
|------------------|-----------------------------------|-----------------------------------|
| Angola           | 7.9                               | 1.57                              |
| Benin            | 75.5                              | 0.50                              |
| Botswana         | 7,213.9                           | 2.13                              |
| Burkina Faso     | 2.3                               | 3.33                              |
| Burundi          | 1.3                               | 4.70                              |
| Chad             | 24.2                              | 2.13                              |
| Comoros          | 32.7                              | 0.90                              |
| Congo            | 79.9                              | 0.56                              |
| Congo, Dem. Rep. | 29.4                              | 1.14                              |
| Eritrea          | 72.0                              | 2.24                              |
| Ethiopia         | 16.6                              | 3.81                              |
| Gabon            | 21.7                              | 0.76                              |
| Ghana            | 26.0                              | 0.48                              |
| Guinea           | 13.7                              | 4.44                              |
| Liberia          | 6.3                               | 1.48                              |
| Madagascar       | 700.4                             | 1.48                              |
| Mauritius        | 86.7                              | 0.97                              |
| Mayotte          | 67.7                              | 0.79                              |
| Namibia          | 6,401.2                           | 2.50                              |
| Seychelles       | 8.7                               | 1.23                              |
| Sierra Leone     | 9.1                               | 1.44                              |
| Swaziland        | 301.9                             | 2.32                              |
| Uganda           | 42.8                              | 1.52                              |
| Zimbabwe         | 4,026.3                           | 2.29                              |

Source: *Intra- and Extra-EU Trade Statistics*.

### *Underutilization of beef preferences*

It is common that the EU beef preferential export quotas are underutilized, meaning that the export volume is less than the preferential quota, regardless of their significant potential benefits. According to Manchin (2004), the utilization rate of Cotonou preferences in the agriculture sector averages 62 percent. The largest beneficiary, Botswana, has also failed to meet even half the quota for recent years. Madagascar has not exported beef to the European market since 1999, and Zimbabwe ceased exporting to the EU in 2001.

Table 5. Preferential Quota Utilization Rate, 1990–2004  
(In tons, unless otherwise indicated)

|            | Preferential<br>export quota | Average export<br>volume | Utilization rate<br>(In percent) |
|------------|------------------------------|--------------------------|----------------------------------|
| Botswana   | 18,916                       | 7,214                    | 38.1                             |
| Kenya      | 142                          | 0                        | 0.0                              |
| Madagascar | 7,579                        | 700                      | 9.2                              |
| Namibia    | 13,000                       | 6,401                    | 49.2                             |
| Swaziland  | 3,363                        | 302                      | 9.0                              |
| Zimbabwe   | 9,100                        | 4,026                    | 44.2                             |

Source: *Intra- and Extra-EU Trade Statistics*.

There are several common reasons for Africa's poor export performance in this industry. First, this partly results from accelerated diversification of livestock products in the region.

The concentration ratio of beef and veal in total meat production has been falling in general, except for several countries.<sup>22</sup>

Second, two exogenous shocks have severely affected the global cattle industry since the late 1990s. One is the outbreak of the foot and mouth disease. Over the region a considerable amount of cattle had to be killed in affected areas. Another is the Bovine Spongiform Encephalopathy (BSE) disease crisis. Although the BSE disease is nothing new, many industrial countries have become more sensitive than before, resulting in a successive imposition of higher food standards on beef exporters.<sup>23</sup> Given the increasing public awareness of these diseases, the European Union, which is the major market for African exporters, required beef exporting countries to fence their cattle farms in 2000, and imposed a new food origin regulation in the next year. According to the new rule, beef products exported to the EU market must be traceable, particularly when imported from countries with a history of the BSE outbreak. The cost of complying with high export conditions is prohibitively high for small volume exporters, such as Swaziland and Botswana, though the latter is one of the few countries in Africa classified by the EU as being largely free from the BSE risk.

The BSE impact appears to have been tremendous in the EU beef market. Consumers became more sensitive to the country of origin. Loureiro and Umberger (2005) estimate the mean willingness to pay for a mandatory origin labeling program at about 20 U.S. cents per pound. The average import prices from non-EU member countries jumped from 2.5 euro to 4 euro after the SEAC report warning the BSE disease (Figure 5). This means either that the food safety measures increased production costs or that a supply shortage due to suspended imports from disqualified countries raised the market price. As per Mazzocchi *et al.* (2004),

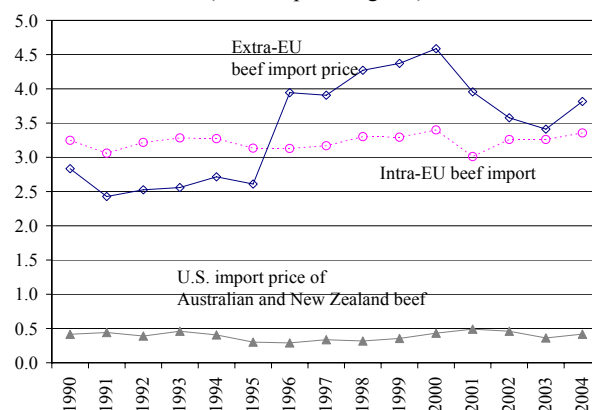
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<sup>22</sup> Botswana reduced the beef share from 85 percent in 1980 to 65 percent in 2004 and instead increased chicken production (source: *FAOSTAT*). There are only seven African countries that experienced an increase in the share of beef in total meat production during the same period: Benin, Chad, Djibouti, Guinea Bissau, Mali, Namibia and Rwanda.

<sup>23</sup> In March 1996, the U.K. Spongiform Encephalopathy Advisory Committee (SEAC) reported that human beings might be able to be infected with the variant Creutzfeldt-Jakob disease through the BSE-infected bovine offal.

notably, the impact of the crisis on beef demand looks permanent given their demand estimation. This BSE effect will be taken into account in the following empirical analysis.

Figure 5. EU and U.S. Import Prices of Beef, 1990-2004  
(In Euro per kilogram)



Sources: *Intra- and Extra-EU Trade Statistics*; and WEO database.

Third, Sub-Saharan Africa has repeatedly suffered from severe droughts over the past decades. As occurred periodically, most beef exporters in the region have reduced cattle processing due to the recent draught.

Finally, there is an alleged notion that lack of adequate processing, transport and telecommunications infrastructure would undermine beef export performance of Africa. Abattoirs are obviously part of important infrastructure.<sup>24</sup> Poor road network would be a crucial bottleneck for improving livestock productivity in the region (Buys *et al.*, 2006; Pinstrip-Anderson, Shimokawa, 2006; Williams *et al.*, 2006; Broadman, 2007). Moreover, without appropriate infrastructure for communication and education, it would be difficult to develop an effective marketing and production system. Marketing inefficiency may be prominent, particularly when state-owned enterprises interfere with trading activities.<sup>25</sup>

<sup>24</sup> One of the common problems for cattle farmers in Africa is that there are a limited number of abattoirs in a country; farmers have to pay high costs to deliver their cattle to an abattoir.

<sup>25</sup> In Botswana, a state-owned enterprise, Botswana Meat Commission, which has exclusive responsibility for marketing beef products abroad, has been a loss-maker. Its untimely cattle collection and slow payment to farmers may be complicating inefficiency in livestock production and export.

### *Trade preference margins for beef exporters*

The calculated preference margins reveal that the EU preferences are very beneficial to countries classified under the protocol. The preference margin is defined as the percentage by which the unit price received by a preference beneficiary exceeds the world free-market price. Under the assumption that there are no other significant beef preferences than the Cotonou protocol, the margins for the major African exporters to the EU tend to exceed more than 200 percent for the period 1996–2004 (Table 6).<sup>26</sup> The U.S. beef import prices of Australian beef are used as a proxy for the world free-market price. Even if compared with the unit price of intra-EU beef imports, the preference margin still ranges between 30 and 50 percent. Significantly, such high preference margins bring about vulnerabilities of these favored countries, because the special beef and veal protocol would likely be replaced with more WTO-compatible trade arrangements in 2008. Thus, the above estimates mean that at least two-third of the current beef export revenues would sooner or later disappear. This seems much larger than McDonald's (2002) assessment.

From the EU point of view, it also means that beef preferences are very costly. Through excluding low-price competitors from the market, EU residents are paying 4–5 times as high prices as the world price that could be offered without the beef protocol.

Table 6. Preference Margin for African Beef Exporters, 1996–2004  
(In percent)

|   | 1996  | 1997   | 1998  | 1999  | 2000  | 2001  | 2002  | 2003  | 2004  |
|---|-------|--------|-------|-------|-------|-------|-------|-------|-------|
| Botswana                                    | 317.9 | 391.6  | 420.6 | 447.2 | 529.0 | 500.8 | 607.0 | 501.8 | 532.8 |
| Madagascar                                  | 257.0 | 340.9  | 183.0 |       |       |       |       |       |       |
| Namibia                                     | 144.5 | 168.2  | 199.4 | 337.7 | 339.1 | 435.3 | 465.3 | 162.9 | 611.3 |
| Swaziland                                   | 318.3 | 1141.2 | 588.2 | 222.5 | 313.1 | 252.9 | 444.7 | 443.5 | 347.7 |
| Zimbabwe                                    | 458.7 | 513.0  | 388.9 | 332.8 | 424.0 | ...   |       |       |       |
| Memorandum items:                           |       |        |       |       |       |       |       |       |       |
| U.S. beef import prices<br>(US\$ per kg) 1/ | 0.37  | 0.38   | 0.36  | 0.38  | 0.40  | 0.44  | 0.43  | 0.41  | 0.52  |
| Exchange rate (euro per<br>US\$) 2/         | 0.79  | 0.88   | 0.89  | 0.94  | 1.09  | 1.12  | 1.06  | 0.89  | 0.81  |

Source: Author's estimates based on *FAOSTAT* and *Intra- and Extra-EU Trade Statistics*.

1/ IMF Primary Commodity Prices.

2/ The ECU was replaced with euro at a rate 1:1 in January 1999.

<sup>26</sup> As discussed above, the preference margin approach tends to overestimate the impact of trade preferences. But it is undeniable that countries under the protocol have been offered a significant benefit.



### III. METHODOLOGY

#### ***Production***

Suppose that a beef exporter  $j$  maximizes the following profit function in terms of the local currency:

$$\pi_{jt} = \left( \frac{p_{jt}^*}{ER_{jt}} - MC_{jt} \right) s_{jt} (\bar{p}_t^*) \bar{M}_t - FC_{jt} \quad (1)$$

$s_{jt}$  is the import market share of exporting country  $j$  at time  $t$ , and  $\bar{M}_t$  is the potential size of EU import market. Accordingly,  $s_j \bar{M}$  is the quantity of exports of country  $j$ .<sup>27</sup>  $MC_{jt}$  and  $FC_{jt}$  are the marginal and fixed costs of beef production, respectively.  $p_{jt}^*$  denotes the import value per unit at customs in euro terms.  $ER_{jt}$  is the exchange rate of the euro against the national currency.  $\bar{p}_{jt}^*$  is the final market price of beef imported from country  $j$ , which reflects the average rate of customs duties  $\tau_j$  applicable to country  $j$ :

$$\bar{p}_{jt}^* = (1 + \tau_j) p_{jt}^* . \quad (2)$$

In Equation (1),  $s_j (\bar{p}_j^*)$  means that exporters are faced with their own down-sloping demand functions and the market share is dependent on the retail prices they set in the destination market.

The marginal production cost could be affected by both exogenous and endogenous factors. The marginal cost of beef production is assumed a function of (livestock-related)

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<sup>27</sup> One crucial limitation of the model is that no significant capacity constraint is assumed existent. Rather, the model will capture the possible capacity constraints, e.g., lack of infrastructure, through the marginal cost of production increased by insufficient infrastructure provision.

infrastructure stocks ( $INF_{jt}$ ), a set of weather conditions ( $Z_{jt}$ ), the shadow price of labor ( $w_{jt}$ ), and the level of production (exports):

$$MC_{jt} = f(INF_{jt}, Z_{jt}, w_{jt}, s_{jt} \bar{M}_t) \quad (3)$$

In the equation the infrastructure variable is a policy instrument and often referred to as a productivity shifting factor in the supply function; it could lower production costs. The current and past weather conditions, which are exogenously given by nature, are likely to influence livestock production costs. As per Williams *et al.* (2006), one of the major factors affecting the livestock market in West Africa was severe droughts, as occurred once a decade. The cost of raising cattle must be anchored by the reservation price of labor in the exporting country. In the African context, cattle-raising is by and large labor-intensive; it is not “factory farming” unlike industrial economies. In addition, livestock is commonly deemed a last resort for livelihood in Africa. Finally, the market share, which is obviously endogenous, is supposed to capture economies of scale in beef production and trade; the larger volume of exports could save the unit cost of transport and advertisements. In fact, the low volume of intraregional trade in Africa is often identified as one of the major reasons for high regional trade costs (Broadman, 2007).

The first order condition of Equation (1) with respect to  $\bar{p}_{jt}^*$  is in general a differential equation of  $f(\bullet)$  but can be simplified to a reduced-form function under certain assumptions.<sup>28</sup> The following linear equation is assumed:

$$\bar{p}_{jt}^* = \alpha_0 + \alpha_1 I_{\{t < 1997\}} + \alpha_2 \Delta ER_{jt} + \alpha_3 \ln INF_{jt} + Z'_{jt} \alpha_4 + \alpha_5 \ln w_{jt} + \alpha_6 \ln s_{jt} + \varepsilon_{1jt} \quad (4)$$

Note that the exchange rate effect is represented by the annual percentage change in the exchange rate. The exchange rate appreciation is expected to raise the destination market prices under the full pass-through assumption, and vice versa. To keep the system of

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<sup>28</sup> The most essential assumption is that the derivative of marginal cost with respect to quantity is small enough.

equations simple, the scale effect associated with the volume of exports is measured in logarithms. The expected effect is unchanged; beef export prices would decrease with the market share. Finally, the dummy variable for years before 1997 is introduced to account for the negative effect of the BSE crisis. It is plausible that after the crisis beef exporting developing countries might begin bearing additional export costs, which are likely to reduce their competitiveness in the international market.

### *Consumer choice*

On the demand side a simple discrete consumer choice model is applied to the EU beef and veal import market, essentially to estimate the demand elasticity. Following the industrial organization literature (e.g., McFadden, 1974; Trajtenberg, 1989; Berry, 1994; and Nevo, 2001), suppose that a representative importer  $i = 1, \dots, I$  decides to purchase one unit of beef from a variety of country-brands  $j = 0, \dots, J$ , and maximizes the following linear indirect quasi-utility function:<sup>29</sup>

$$u_{ijt} = \lambda \bar{p}_{jt}^* + x_j' \beta + \Delta \xi_{jt} + \varepsilon_{2ijt} \quad (5)$$

where  $x_j$  and  $\Delta \xi_{jt}$  are a set of brand-specific characteristics and a brand-specific deviation from the mean brand valuation. Assume that products are not perfectly substitutable, and the country-specific quality of beef is considered unchanged over time. When the idiosyncratic error term ( $\varepsilon_2$ ) is independently and identically distributed according to Type I extreme value distribution, such as  $\exp(-\exp(-\varepsilon))$ , Equation (5) yields the conventional market share equation:

$$\ln s_{jt} - \ln s_{0t} = \lambda \bar{p}_{jt}^* + x_j' \beta + \Delta \xi_{jt} \quad (6)$$

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<sup>29</sup> In practice, it is less likely that consumers are directly involved in the arbitrage process in the international trade market. Rather, wholesalers purchase from exporters. However, their buying behavior is naturally predetermined by consumer preferences.

where  $s_0$  is the share of an outside option  $j = 0$ , which is defined as a choice of consuming beef from intra-EU countries, rather than importing from outside regions. The mean utility level of this outside alternative is normalized to zero. For empirical simplicity, the brand-specific characteristics in Equation (6) are assumed to be represented by the country-specific fixed-effect.

### ***Estimation method and econometric issues***

Given the demand and supply equations, a three-stage least squares (3SLS) technique is used to estimate the market share and market prices, both of which are jointly determined in Equations (4) and (6). This is a typical approach to the supply and demand system equations (e.g., Greene, 2000; Epple and McCallum, 2006).

In addition to the price-quantity simultaneity, another endogenous problem would be created when per capita GDP data are used as a proxy variable for the shadow price of labor. It is obvious that national income consists of beef export earning, which is dependent on  $\bar{p}_{jt}^*$  and  $s_{jt}$ . To deal with this endogeneity problem, the 1-year lagged GDP data are used for  $w$ . Although this treatment may not completely solve the underlying endogeneity, it is worth noting that the main estimation results from the data in hand are not changed even if different lags are allowed for.<sup>30</sup>

However, even if the lagged value of GDP per capita can be treated as exogenous, one might remain concerned about endogeneity between national income and infrastructure stocks. This is a well-documented empirical problem in the growth literature (e.g., Esfahani and Ramírez, 2003; Fay, Yepes, 2003; Calderón and Servén, 2004). While accumulated capital stocks will allow to promote economic growth, the high level of national income can afford more

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<sup>30</sup> The simple correlation between the lagged GDP per capita and beef exports is -0.04. The export price and quantity are also not correlated with the GDP per capita (0.32 and -0.05, respectively).

infrastructures.<sup>31</sup> To solve this simultaneity issue, the following equation is added to the system:

$$\ln INF_{jt} = \gamma_0 + \gamma_1 \ln GDP_{percapita_{jt-1}} + \varepsilon_{3jt} \quad (7)$$

It assumes that infrastructure stocks are determined by per capita GDP. As the result, we have a three-equation system consisting of Equations (4), (6) and (7) with three endogenous variables (i.e.,  $s_{jt}$ ,  $\bar{p}_{jt}^*$ ,  $INF_{jt}$ ), and they are jointly estimated by the 3SLS method.

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<sup>31</sup> The recent empirical growth literature mostly accepts that the contribution of infrastructure services is substantial even after controlling for endogeneity between economic growth and infrastructure development.

#### IV. DATA

The sample data cover at maximum 136 countries that have exported beef and products to the EU market from 1990 to 2004.<sup>32</sup> The trade data come from *Intra- and Extra-EU Trade Statistics*, which provide both quantity and value information on EU imports of “beef.”<sup>33</sup> The import values are deflated by the consumer price index in the region (1989=100). The average unit price is calculated by the deflated import value divided by quantity. Accordingly, the unit price is defined in terms of the ECU or euro per kilogram.<sup>34</sup> For conversion purposes, the period average exchange rates are used from the IMF *International Financial Statistics (IFS)*.

Since the rate of customs duties varies across individual exporters, the paper assumes that the average most-favored-nation (MFN) tariff of beef products, which is estimated at about 200 percent (Morath, 1997), could apply for all countries that are not covered by the Cotonou beef protocol. By contrast, the beneficiary countries are supposed to enjoy zero in-quota tariffs—though not exactly zero even under the limit. Technically, there is another potentially level of tariff in the EU’s beef import market, because the EU offers the Generalized System of Preferences (GSP) as well as than the Cotonou protocol. However, since the utilization of the GSP has been limited (Rocha, 2003; Manchin, 2004), the final prices of beef products imported from non-beneficiary countries are simply assumed three times as high at the destination market as their customs prices.

The potential market size of European import beef is defined by the sum of beef imported by EU15 members from intra- and extra-region countries. To focus on examining the market access from outside regions, intra-regional imports are considered as an alternative option. It is noteworthy that the current analysis investigates a partial equilibrium in the sense that beef exporters outside the EU are supposed to compete with only themselves and intra-EU

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<sup>32</sup> In this analysis the EU market includes Austria; Belgium; Denmark; Finland; France; Germany; Greece; Ireland; Italy; Luxembourg; Netherlands; Portugal; Spain; Sweden; and the United Kingdom.

<sup>33</sup> It includes fresh, chilled and frozen meat of bovine animals under category numbers 201 and 202.

<sup>34</sup> The ECU is a basket of EU currencies, which was replaced with euro at a rate of 1:1 on January 1, 1999.

exporters; no substitution effect of domestic production is considered, and any other export markets than the EU are ignored.<sup>35</sup> In theory, however, the EU market must reflect and be connected to the supply and demand conditions in the global markets through international arbitration based on the internal exchange rates.

For each country, two weather variables are introduced from the National Oceanic and Atmospheric Administration (NOAA) database, the Global Historical Climatology Network (GHCN) Version 2: average annual temperature and average annual precipitation. In order to take into consideration the possible persistence of past weather impacts, two lagged values are initially introduced in Equation (4). When a country has more than one observatory, they are averaged on the national level. If there is no available data for a particular country, its neighboring country's data are used to maximize the sample size.<sup>36</sup>

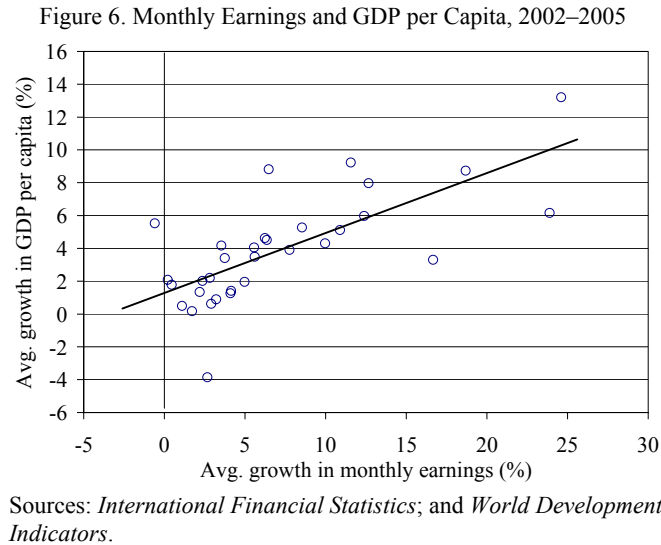
The exchange rate variable, *ER*, is defined as annual changes in the bilateral exchange rate of the euro against the national currency; an increase in *ER* means the exchange rate appreciation, which would have an adverse effect on local exporters through raising their export prices. The associated coefficient in the export price equation is expected to be positive.

The shadow price of labor is measured by pre capita GDP (in constant 2000 US\$ terms), which is largely available for most country and thus allows us to use our trade data in hand to the maximum extent. This is potentially a rough proximation; however, not surprisingly, GDP per capita is highly correlated with monthly earnings for countries whose data are available (Figure 6). Data on the exchange rates and GDP per capita depend on *IFS* and *World Development Indicators (WDI)*.

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<sup>35</sup> For instance, large beef exporters in Latin America, such as Argentina and Brazil, experienced an economic boom in the sample period and boosted their exports to the United States. This may not be captured directly by our framework.

<sup>36</sup> These treatments may create a risk of discarding much information in the original data, particularly for geographically large countries. Indeed, these weather variables have been found too noisy to explain livestock production in the sample.



Six variables are adopted for a proxy of *INF*: road density, share of paved roads, electricity consumption per capita, teledensity, gross fixed capital formulation (*GFCF*), and public *GFCF*. In addition, another variable representing educational access is also considered, since literacy could matter for effective sales and marketing communication (Williams *et al.*, 2006).

Ideally, *INF* should be measured by “livestock-specific infrastructure” if such a variable existed. In reality, it seems difficult to capture livestock-related infrastructure by any single available measurement, particularly in the cross-sectional context. Infrastructure that farmers rely on for raising cattle may vary from country to country. If a modern system of “factory farming” is adopted, production efficiency is determined by feeds and investments in machinery and equipment (e.g., Ramsey *et al.*, 2005). Then, the most important infrastructures would be electricity and water. If livestock or deadstock are mass-transported, another essential infrastructure would be railways network.

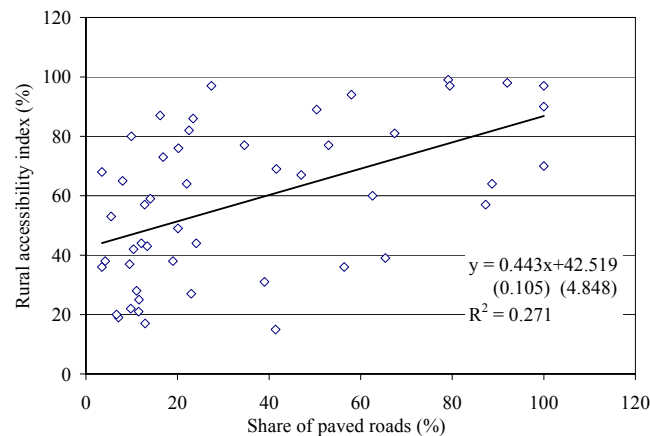
In Africa, however, this is not the case in general. Africa’s livestock industry is a more traditional type of livestock grazing. It seems most costly for local farmers to convey their livestock to a slaughterhouse; in this regard rural roads are the most important infrastructure besides abattoirs and warehouses, which are obviously part of essential infrastructure in this industry. Transport infrastructure from abattoirs to major ports may also be important. All in all, road network seems to be a key to enhance efficiency in livestock production and trade in



the African region (Williams *et al.*, 2006). Most of the agricultural economics literature indeed focuses on the effects of road development (Pinstrup-Anderson, Shimokawa, 2006).

There is a good measurement which is most relevant to rural road development, i.e., “rural access index” developed by Roberts *et al.* (2006). Unfortunately, however, the time series data are unavailable. Although the level of infrastructure cannot be changed in the short run, more variation in data is desirable for econometrics purposes. The current paper relies on two conventional road development indices: the share of paved roads and road density, which appear broadly positively correlated with the rural access index as far as data are available (Figure 7).<sup>37</sup> Of particular note, the quality of roads is expected to have an important role to play in expanding trade opportunities in many earlier studies (Buys *et al.*, 2006; Broadman, 2007).

Figure 7. Consistency Check between Road Accessibility Index and Paved Road Share, 1993–2004



Sources: Roberts *et al.* (2006); and *World Development Indicators*.

Non-transport infrastructures, such as electricity and telecommunications, may also be conducive to improving efficiency in livestock production and marketing, along with education (Timmer, 2002; Williams *et al.*, 2006). In fact, a common perception in Africa is that livestock is a last resort for livelihood, implying that a full set of basic rural infrastructures may be necessary for supporting livestock activities in rural areas. Rural areas with low standards of living cannot rein rural-urban migration.

<sup>37</sup> Also see Queiroz and Gautam (1992).

The paper will take advantage of an alternative approach using national accounts data. Some countries have data on fixed capital formation for the livestock sector; however, such breakdown is not always available in developing countries. The investment rate, which is gross fixed capital formation (GFCF) divided by GDP, is used as a proxy for infrastructure investment. Additional attention will be paid to the public GFCF ratio, since agricultural infrastructure is mostly invested by the government. These are weakly associated with the road infrastructure variables on a correlation basis. Although the sectoral composition of investment is never uncovered by this approach, there could be general policy implications for public investment in the livestock industry.

## V. MAIN ESTIMATION RESULTS

Table 7 presents the three-stage least squares estimates of the system of equations. First, the price coefficient in the market share equation is significantly negative. This is consistent with basic economic theory, but more than that, it should be emphasized that the EU beef import market is “competitive” despite the given strong trade preferences. If exporters cannot reduce their relative export prices, they would lose their market share in the EU market. Using the coefficient of -0.434 in the third column model, the (partial) price elasticity of demand for imported beef is estimated at -2.8 on average, meaning that a 1 percent reduction in export prices would raise the market share by 2.8 percent. This is not contradictory to the existing evidence of beef demand elasticity (Reed and Saghaian, 2004). The price elasticity of the market shares is calculated as follows:

$$\frac{\partial s_j}{\partial p_k} \frac{p_k}{s_j} = \begin{cases} \lambda \bar{p}_j^* (1 - s_j) & \text{if } k = j \\ -\lambda \bar{p}_k^* s_k & \text{otherwise} \end{cases} \quad (8)$$

where a parameter,  $\lambda$ , is estimated in Equation (6).

How can we achieve lower export prices? The results suggest that infrastructure developments, rather than the exchange rate, would play an important role in lowering beef export prices. The expected impact varies depending on types of infrastructure. The quality of roads measured by the share of paved roads is a significant contributor to beef export success. The coefficient is significantly positive at -0.566. The road density representing the quantity of roads also has a negative coefficient but it is statistically insignificant. These pieces of evidence can be interpreted to mean that the road network expansion may be necessary but perhaps useless without the quality maintained.

Improved telecommunications infrastructure may allow effective integration of market information, but the impact seems marginal in the livestock industry. The coefficient of teledensity is negative but insignificant. Rather, electricity infrastructure can directly and indirectly enhance livestock productivity. The estimated coefficient implies that an 1 percent

increase in electricity consumption would lead to some 0.8 percent reduction in beef export prices.

The effect of education, possibly literacy, on livestock production is affirmative but still arguable due to the problem of insufficient observations. When access to education is measured by the gross secondary school enrollment rate, the sample size will be restrictive relative to the number of parameters to be estimated. To save the degree of freedom, the endogeneity associated with the trade volume in the price equation is discarded. The estimation result is relatively unstable. In addition, the price coefficient in the share equation turned out positive, which is usually unexpected.

Ignoring the composition and nature of investment, the gross domestic investment has a significant influence to reduce beef export prices. The coefficient of *GFCG* is estimated at  $-2.661$ . The public investment also seems productive—but less strongly than the total investment—for promoting the livestock industry. Although no information on how to allocate resources is provided in the model, a certain fraction of public sector resources is presumed to be spent on agricultural infrastructure, such as rural roads and electricity. If it is the case, a rigorous commitment to invest in livestock-related infrastructure may result in intensifying this positive relationship between public investment and livestock productivity.

From the macroeconomic policy point of view, it is noteworthy that the exchange rate adjustment does not help much for fundamental external competitiveness. The exchange rate coefficient tends to be positive—meaning that the exchange rate appreciation may erode competitiveness—but statistically insignificant regardless of specifications. In addition, the dummy variable for years before 1997 has a negative coefficient, as expected; however, it is not significant. These are interpreted to mean that beef exporters may not be allowed to pass through the exchange rate appreciation and additional costs of food safety measures against the BSE crisis.<sup>38</sup> This is another piece of evidence of intense competition of the EU beef market.

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<sup>38</sup> Though, the BSE impact looks considerable at least on a simple average basis, as depicted in Figure 5.

The positive coefficient of per capita GDP, which is employed as a proxy for labor costs, has two interpretations. First, it means that higher domestic wages make it more difficult to maintain external competitiveness, as usually expected. Second, it also means that there remains a potential for trade expansion by removing labor rigidity through structural reforms in labor markets. Notably, the latter seems much meaningful for developing countries whose wages are set above the market clearing level with little labor mobility.

The weather variables have been found less significant and thus omitted from the model. Formally, in most specifications, the standard Wald tests cannot reject the null hypothesis that the coefficients of temperature or precipitation variables are indifferent from zeros.

Finally, the estimation results show that livestock processing and trade exhibit marked economies of scale. The coefficient of  $\ln s_j$  in the price equation is estimated at  $-0.44$  to  $-0.79$  after the simultaneity issue is controlled for. The export price elasticity with respect to market share ranges from 0.106 to 0.190 in absolute terms, depending on which infrastructure variable is used.<sup>39</sup> If a beef exporter increase the market share by 1 percent, its unit price could be reduced by about 0.1–0.2 percent because of economies of scale. This scale effect may look smaller than expected but could be potentially powerful together with the relatively high price elasticity of demand (i.e., 2.8 in absolute terms). Apparently, this must be the original reason for the Cotonou Agreement providing trade preferences to small-volume exporters in the ACP region. At the same time, it will continue to be a serious challenge for the protocol countries after the Cotonou Agreement expires; they would be likely to suffer from scale diseconomies.

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<sup>39</sup> They are evaluated at the mean levels.

Table 7. Three Stage Least Squares Estimation Results

|                                      | (1)                   | (2)                   | (3)                   | (4)                   | (5)                   | (6)                   | (7)                    |
|--------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|
| Market share equation 1/             |                       |                       |                       |                       |                       |                       |                        |
| $\bar{p}_j^*$                        | -0.350 ***<br>(0.048) | -0.468 ***<br>(0.060) | -0.434 ***<br>(0.051) | -0.326 ***<br>(0.048) | -0.242 ***<br>(0.057) | -0.346 ***<br>(0.048) | 0.107<br>(0.140)       |
| Constant                             | -7.141 ***<br>(0.336) | -6.606 ***<br>(0.373) | -6.879 ***<br>(0.367) | -7.634 ***<br>(0.338) | -7.799 ***<br>(0.420) | -7.183 ***<br>(0.337) | -9.302 ***<br>(0.929)  |
| Price equation 2/                    |                       |                       |                       |                       |                       |                       |                        |
| D(year<1997)                         | -0.144<br>(0.420)     | -0.842<br>(0.527)     | -0.439<br>(0.454)     | -0.152<br>(0.441)     | -0.017<br>(0.484)     | -0.365<br>(0.490)     |                        |
| $\Delta ER$                          | 0.008<br>(0.011)      | -0.003<br>(0.012)     | 0.008<br>(0.011)      | 0.004<br>(0.011)      | 0.010<br>(0.011)      | 0.0002<br>(0.010)     | 0.007<br>(0.018)       |
| $GFCF$                               | -2.661 ***<br>(0.859) |                       |                       |                       |                       |                       |                        |
| Public $GFCF$                        |                       | -1.224 ***<br>(0.382) |                       |                       |                       |                       |                        |
| Share of paved roads                 |                       |                       | -0.566 **<br>(0.294)  |                       |                       |                       |                        |
| Road density 3/                      |                       |                       |                       | -0.218<br>(0.250)     |                       |                       |                        |
| Electricity consumption              |                       |                       |                       |                       | -0.759 **<br>(0.372)  |                       |                        |
| Teledensity                          |                       |                       |                       |                       |                       | -0.203<br>(0.278)     |                        |
| Secondary school enrollment rate     |                       |                       |                       |                       |                       |                       | -14.833 ***<br>(4.736) |
| $\ln GDP_{percapita} (-1)$           | 1.059 ***<br>(0.146)  | 0.550 **<br>(0.253)   | 0.869 ***<br>(0.178)  | 0.969 ***<br>(0.160)  | 1.667 ***<br>(0.359)  | 1.201 ***<br>(0.313)  | 5.224 ***<br>(1.285)   |
| $\ln s_j$                            | -0.635 ***<br>(0.070) | -0.779 ***<br>(0.092) | -0.787 ***<br>(0.081) | -0.671 ***<br>(0.081) | -0.440 ***<br>(0.082) | -0.649 ***<br>(0.070) |                        |
| Constant                             | -0.065<br>(2.923)     | -3.772<br>(2.555)     | -5.982 ***<br>(1.737) | -7.897 ***<br>(1.627) | -5.138 ***<br>(1.851) | -8.341 ***<br>(1.623) | 25.522 **<br>(10.407)  |
| Infrastructure provision equation 4/ |                       |                       |                       |                       |                       |                       |                        |
| $\ln GDP_{percapita} (-1)$           | 0.034 ***<br>(0.009)  | -0.066 *<br>(0.040)   | 0.253 ***<br>(0.032)  | 0.178 ***<br>(0.031)  | 0.836 ***<br>(0.024)  | 0.970 ***<br>(0.030)  | 0.269 ***<br>(0.017)   |
| Constant                             | 2.755 ***<br>(0.075)  | 2.073 ***<br>(0.303)  | 1.609 ***<br>(0.260)  | -0.910 ***<br>(0.253) | 0.912 ***<br>(0.201)  | -2.746 ***<br>(0.247) | 2.161 ***<br>(0.139)   |
| Obs                                  | 468                   | 294                   | 319                   | 375                   | 387                   | 475                   | 152                    |
| Chi-square statistics                |                       |                       |                       |                       |                       |                       |                        |
| Market share equation                | 53.10 ***             | 61.15 ***             | 72.74 ***             | 45.90 ***             | 17.97 ***             | 52.61 ***             | 0.58                   |
| Price equation                       | 124.09 ***            | 81.22 ***             | 113.20 ***            | 96.51 ***             | 66.08 ***             | 122.85 ***            | 58.39 ***              |
| Infrastructure provision equation    | 13.27 ***             | 2.71 *                | 63.41 ***             | 33.28 ***             | 1203.95 ***           | 1036.79 ***           | 262.36 ***             |
| Weather variables                    |                       |                       |                       |                       |                       |                       |                        |
| Temperature                          | No                    | No                    | No                    | No                    | No                    | No                    | No                     |
| Precipitation                        | No                    | No                    | No                    | No                    | No                    | No                    | Yes                    |

Source: Author's calculations.

1/ The dependent variable is  $\ln s_{jt} - \ln s_{0t}$ .

2/ The dependent variable is  $\bar{p}_j^*$ .

3/ The logarithm is not taken for the road density variable.

4/ The dependent variable is each infrastructure variable in the price equation.

## VI. DISCUSSION

### *Implied price cost margins*

According to the implied price cost margins (PCMs), there is no clear evidence that trade preferences could have been particularly instrumental in achieving higher underlying profitability of beef production. From the first order condition of Equation (1), the price cost margin can be written by:

$$\frac{p_j - MC_j}{p_j} = - \left[ \frac{\partial s_j}{\partial \bar{p}_j^*} \frac{\bar{p}_j^*}{s_j} \right]^{-1} + \phi(\bullet) \quad (9)$$

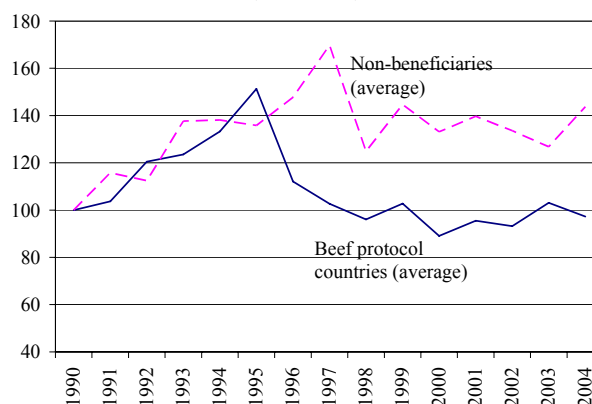
where  $\phi(\bullet)$  is essentially a function of the derivative of marginal cost with respect to quantity and other constant factors. If we can ignore the second term in Equation (9), the implied price cost margin is simply the inverse demand elasticity.<sup>40</sup>

The preference beneficiary countries are relatively lagging behind in improving the profit margins compared with non-beneficiaries (Figure 8). This does not mean that trade preferences would have harmed beneficiary countries. The granted preferences may have a positive effect, but the impact does not seem to have been large enough to overcome efficiency improvements by non-beneficiary countries. Notably, the PCMs improved significantly in the 1990s before the BSE crisis. After the crisis, however, the profitability for the Cotonou beneficiaries dropped to the level in 1990. Although the BSE crisis has adversely affected both beneficiary and non-beneficiary countries, the average margin for the latter group of countries remains 40 percent higher than their 1990 level.

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<sup>40</sup> This is not an unreasonable assumption because the empirical results indicate that the elasticity of export prices with respect to quantity is very modest, as shown above.

Figure 8. Implied Price Cost Margins, 1990–2004  
(1990=100)



Source: Author's calculations.

The above evidence may raise a general question of why trade preference programs may be an ineffective instrument to assist the agriculture sector in developing countries. One main reason, which seems plausible in the current beef preference context, is that a commitment to the temporariness of granted preferences is not credible enough.<sup>41</sup> As suggested by the Mill-Bastable test, the protection must be temporary. Although the Cotonou Agreement is transitory and supposed to be replaced with more WTO-compatible arrangements in 2008, the expectation may persist that the commodity preferences would be carried over to the next trade regime.

### *Counterfactual examples of infrastructure developments*

One of the important policy implications of the estimation results is that accumulated infrastructure stocks could facilitate livestock production and trade. For illustrative purposes the impact of infrastructure development is inferred from the estimated equations. Suppose that infrastructure would be developed to the 75 percentile level of the sample.<sup>42</sup> The case of road quality improvement measured by the share of paved roads is examined as an example, because it yielded one of the significant estimation results.

<sup>41</sup> Another reason for unpromising performance of trade preferences is that high import tariffs to keep privileged countries producing would cause large welfare losses in terms of consumption and production distortion costs. In theory, the infant industry literature suggests that direct production subsidies are rather better (Corden, 1997).

<sup>42</sup> This is assumed an exogenous shock; thus, all other relevant consequences are ignored, such as investment costs.



To see the long-term impact, the total elasticities of export prices and market share are calculated taking the limits of  $s_j$  and  $\bar{p}_j^*$ . Note that in our empirical model, an instantaneous increase in infrastructure stocks would lead to lower export prices, which would in turn help to increase the market share. Then, it would cause an additional price reduction due to economies of scale in production and export. Since the elasticity of export prices with respect to market share is relatively low, the long-term impact in question has been found to converge.<sup>43</sup>

First, improved infrastructure could always contribute to lowering export prices and enhancing external competitiveness. The price elasticity ranges between 0.14 and 0.65 in absolute terms (Table 8). Second, infrastructure also contributes to export expansion on a volume basis. The elasticity of quantity is estimated at 0.36-0.37. The overall effect of infrastructure on exports (value terms) is dependent on which of the two total elasticities is the greater. While the projected gain for Namibia could reach 4 million euro or 0.1 percent of GDP, the possible reduction in exports for Madagascar might amount to 6 million euro or 0.2 percent of GDP.<sup>44</sup> In general, countries whose products have a relatively low price elasticity of demand are less likely to receive a positive elasticity of exports with respect to infrastructure development. This is often the case for exporters who has only the limited mass marketing channels in the market. It is intuitively obvious that small volume exporters may not be able to gain the return of infrastructure investment in the short run; rather, long-term efforts toward enlarging retail channels will be necessary.

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<sup>43</sup> The formal condition for convergence is  $\eta_1\eta_2 < 1$ , where  $\eta_1$  and  $\eta_2$  are the price elasticity of demand and the market share elasticity of export prices, respectively.

<sup>44</sup> Instead, provided that the only quantity-based impact is taken into account, the impact of improved infrastructure on beef exports would be on the order of 0.04–1.75 percent of GDP.

Table 8. Numerical Impacts of Infrastructure (Paved Roads) Development

|                   | Partial elasticity                     |                            |  | Total <i>INF</i> elasticity of export prices | Total <i>INF</i> elasticity of market share | Total <i>INF</i> elasticity of exports | Changes in beef exports |               |
|-------------------|--|----------------------------|--|--|---|--|-------------------------|---------------|
|                   | <i>INF</i> elasticity of export prices | Price elasticity of demand | Market share elasticity of export prices |  |   |  | (million euro) 1/       | (% of GDP) 1/ |
| Sample average 2/ | -0.10                                  | -2.56                      | -0.13                                    | -0.14  | 0.36  | 0.22                                   | 1.78                    | 0.001         |
| Botswana          | -0.28                                  | -0.87                      | -0.38                                    | -0.42  | 0.36  | -0.05                                  | -2.47                   | -0.034        |
| Madagascar 3/     | -0.43                                  | -0.56                      | -0.58                                    | -0.65  | 0.37  | -0.28                                  | -6.11                   | -0.194        |
| Namibia           | -0.23                                  | -1.05                      | -0.31                                    | -0.34  | 0.36  | 0.02                                   | 4.08                    | 0.089         |
| Swaziland         | -0.23                                  | -1.06                      | -0.31                                    | -0.35  | 0.37  | 0.02                                   | 0.05                    | 0.002         |
| Zimbabwe 4/       | -0.31                                  | -0.79                      | -0.41                                    | -0.46  | 0.36  | -0.09                                  | -5.69                   | -0.040        |

Source: Author's calculations.

1/ Assume that *INF* would instantaneously improve to the 75 percentile level of the sample for the past five years, while holding the international market price constant.

2/ Including 29 sample countries that exported beef to the EU in 2004.

3/ Evaluated at the data for 1996.

4/ Evaluated at the data for 2001.

## **VII. CONCLUSION**

The livestock industry is one of the important sectors for economic growth and poverty reduction, particularly in rural areas. However, it seems far from conclusive how to promote livestock productivity in developing countries.

The paper investigates the effects of public infrastructure and international trade preferences on efficiency in livestock production and trade. It is commonly accepted that rural infrastructure is essential to stimulate the livestock industry. The paper questions whether infrastructure really matters and what type of infrastructure is most important in this area. On the other hand, there is also an expectation that the provision of trade preferences could facilitate trade integration involving developing countries and promote their economic development. The paper examines to what extent trade preferential arrangements could contribute to achieving higher production efficiency for beneficiary countries.

Using trade from the European Union, the paper focuses on the EU beef import market where several African countries have been granted considerable trade preferences under the Cotonou Agreement. The system of supply and demand equations is jointly estimated by the three-stage least squares estimator. The traditional endogeneity problem between (export) price and quantity is taken into account. In addition, the simultaneity of infrastructure stocks and national income representing the reservation price of labor is also controlled for.

The estimated demand equation shows that the demand elasticity is relatively high and the EU beef import market is competitive in spite of the large degree of distortion caused by trade preferences. It means that less competitive beef producers would easily be excluded from the market.

The estimated supply function reveals that infrastructure, particularly quality roads and electricity, could significantly reduce beef export prices. Telecommunications and education may be important but not conclusive. Public capital expenditure, of which a certain fraction is supposed to be spent on agricultural infrastructure, has a significant impact on export

prices. A strong commitment to allocate resources will be needed to strengthen external competitiveness of the agriculture sector. It is also shown that the size of exports matters to a certain extent. This will be a challenge for small-volume exporters.

Based on the implied price cost margins, there is no significant difference in productivity improvement between trade preference beneficiary countries and non-beneficiaries. This does not mean that trade preferences have no effects. However, the impacts seem to have been very modest. It is suggested that trade preferences might risk relieving beneficiary countries from international competitive pressures and discouraged them from making efforts toward efficiency advance. The Mill-Bastable test tells that it is critical to make the temporariness of granted preferences credible. At the same time, infrastructure, such as rural roads and electricity, is worth developing to materialize the dynamic external learning effects. The estimation results of this paper strongly support that improved infrastructure could reduce export prices, enhance market shares, and strengthen external competitiveness in a sustainable way.

It is noteworthy that in spite of the paper's particular focus, the empirical framework developed here is applicable to any agricultural commodity trade, and the drawn policy implications could be generalized. Recall that besides the infrastructure-productivity linkage, the basic question to be addressed here is whether trade preferences make a contribution to higher efficiency in export production of beneficiary countries.

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